Note From: *Cody Rice, OIAA/EAD/ASB*
Office of Environmental Information

DATE: September 24, 2003

TO: Judith Kendall, OEI/OIAA/TRIPD

RE: Terms of Clearance for TRI ICR Renewal

This memo provides additional information on revised burden hour estimates for Toxics Release Inventory (TRI) reporting as requested by the Office of Management and Budget (OMB) in the Terms of Clearance dated March 10, 2003 for the Information Collection Requests (ICRs) for the TRI Form R (OMB No. 2070-0093) and Form A (OMB No. 2070-0143).

In the Terms of Clearance, OMB stated that "If EPA continues to believe that further adjustments [to burden hour estimates] are appropriate, they should provide additional documentation during the next ICR review cycle. This documentation should specifically address the issue of whether the revised estimates account for all categories of burden, including time for data tracking and assembly; creation, operation and maintenance of data tracking systems; training; and compliance determinations."

This memo addresses the origin and derivation of TRI burden hour estimates used in previous ICRs. This memo also documents and further describes the data that are available to revise estimates of the burden hours associated with TRI reporting.

Existing Burden Hour Estimates

The existing Form R burden hour estimates (*i.e.*, those in the most recent ICR renewal approved by OMB) trace their roots back to the final rule implementing TRI reporting in the late 1980s. These estimates were based primarily on the knowledge and informed judgement of federal personnel who analyzed the reporting form and its associated requirements. These types of estimates are sometimes referred to as "engineering" estimates, because they reflect expert judgement rather than burden hour data from responding facilities. This method is often employed to estimate reporting burden prior to actual reporting. Much of the TRI analysis reflected engineering estimates from an analysis of a previous reporting rule known as the Comprehensive Assessment Information Rule.

In the Regulatory Impact Analysis of the final rule implementing TRI in 1988, the burden for rule familiarization and compliance determination in the first reporting year was estimated to be 34.5 hours for facilities with 50 or more employees and 12 hours for facilities with less than 50 employees. Each subsequent year's compliance determination was assumed to require only one-fourth as much time, as facility staff became familiar with the form and its data requirements. The burden of completing a single Form R was estimated to be 33.2 hours in

the first reporting year. Based on additional expert judgement, it was assumed that subsequent year report completion burden would be 68 percent of the first-year time requirements, or 22.6 hours. Recordkeeping and mailing burden was assumed to be an additional 4 hours per form in both first and subsequent reporting years. The estimates for report completion were validated with a pretest of the proposed Form R among 28 facilities (25 large and 3 small) in the manufacturing industries who were requested to estimate the time required to provide the requested information for one chemical at their facility. The pretest average time for completing the proposed Form R was 29.7 hours per chemical (EPA 1988).

In 1993, EPA revised the burden hour estimates for TRI reporting based on several years of reporting experience and new engineering estimates of the burden associated with data elements added to the From R due to the Pollution Prevention Act of 1990. After 6 years of reporting experience, EPA determined that facilities would tend to make compliance determinations by checking for changes in reporting requirements and at their facilities. As a result, the estimate for subsequent year compliance determination was lowered to 3 hours per facility. At this time, EPA stated that "previous reporting experience and annual utilization of procedures developed by respondents to the program should tend to keep the time required for compliance determination to a minimum." For report completion, EPA adopted a revised estimate of 47 hours per Form R in subsequent reporting years based on an engineering assessment for the additional pollution prevention data requirements (EPA 1993).

For reporting year 1995, EPA added new chemicals to the list of reportable substances, and created a certification statement (Form A) as a burden reduction measure. As a result of the expansion of the chemical list, EPA raised the estimate for subsequent year compliance determination from 3 hours to 4 hours. Adopting the assumption from the original TRI RIA that subsequent year compliance determination takes one-fourth as long as first year compliance determination, EPA back-calculated the revised first year compliance determination burden at 12 hours (EPA 1994b). In the Chemical Expansion and Alternate Threshold Rules and subsequent ICRs, EPA continued to use an estimate of 47 hours per Form R for report completion in subsequent reporting years and 5 hours per Form R for recordkeeping and mailing. Based on the unit time estimates for the data elements on the Form R that are used to determine eligibility for the Form A, the burden of the Form A was estimated at 30.2 hours for calculations, 3 hours for recordkeeping/mailing, and 1.4 hours for form completion (EPA 1994a). These unit burden estimates were used to generate the total burden hour estimate that OMB approved in the last TRI ICR renewal in March 2003.

Respondent Data Addressing TRI Reporting Burden

As described above, the existing TRI reporting burden estimates primarily reflect a series of engineering estimates developed prior to actual reporting. Based on feedback from TRI reporters, it appears that burden hours are actually less than previously estimated. A number of factors may be contributing to the lower realized reporting burden:

- Computerization and automation of data gathering, calculations, report completion, recordkeeping, and submission.
- Increased accessibility of information to facility staff from EPA guidance, trade associations, and the internet.
- Implementation of other state and federal reporting requirements that serve as precursors to TRI reporting and can be used to fulfill TRI reporting requirements.
- Previous burden hour estimates assumed that facilities would enter data in all sections of the form, although this is not the case for most Form Rs.

A review of burden hour data collected from reporting facilities indicates that the existing burden hour estimates substantially overestimate actual reporting burden for most reporting facilities. The existing burden estimates for subsequent year compliance determination, Form R calculations and form completion, and recordkeeping/mailing are above the 95th percentile of per form burden reported by actual TRI respondents (EPA 2002).

For the ICR renewal, EPA developed a revised estimate of 14.5 hours for Form R calculations/report completion in subsequent reporting years. EPA did not change any of the existing estimates for first year reporting burdens, including those for calculations/report completion. EPA also left burden estimates unchanged for subsequent year compliance determination (4 hours per facility) and recordkeeping/submission (5 hours per Form R). For the Form A, EPA also revised the estimate for subsequent year calculations/certification burden to 9.3 hours based on the previous estimate from the Alternate Threshold RIA that calculations for a Form A take approximately 64 percent of the time of calculations for the Form R. This estimate was validated by contacting nine facilities that filed Form As in reporting year 2000. The average of facility-level burden hours per chemical certification was reported at 11.2 to 15.5 hours. EPA's estimate of 13.7 total hours (including 3 hours for recordkeeping/submission and 1.4 hours for form completion) for a facility certifying one chemical on a Form A falls within this range. EPA did not change any of the existing estimates for first year reporting burdens associated with Form A, nor did EPA change estimates of burden for subsequent year recordkeeping/submission (3 hours) and form completion (1.4 hours) for Form A. EPA's burden hour estimates are summarized in the following table. Further details are available in the current ICR supporting statements and a background memo that was prepared for the ICR renewal process (EPA 2002).

TRI Burden Hour Estimates					
Activity		**Hours per year**			**Comments**
		Existing Estimate	**Change**	**Revised Estimate**	
First Year of Reporting					
Facility	Rule Familiarization	34.5	0	34.5	No change in baseline estimates of first year reporting burden due to lack of data. Estimates based on expert judgement, and made prior to actual reporting. Estimates date to beginning of TRI program.
	Compliance Determination	16	0	16	
Form R	Calculations/Form Completion	69	0	69	
	Recordkeeping/Submission	5	0	5	
Form A	Calculations/Certification	44.5	0	44.5	
	Recordkeeping/Mailing	3	0	3	
	Form Completion	2.1	0	2.1	
Subsequent Years of Reporting					
Facility	Compliance Determination	4	0	4	As above, no change.
Form R	Calculations/Form Completion	47.1	-32.6	14.5	Revised based on data from 180 reporting facilities.
	Recordkeeping/Submission	5	0	5	As above, no change.
Form A	Calculations/Certification	30.2	-20.9	9.3	Revised based on assumptions about relative burden of Form R vs. A. Validated by contacting 9 respondents.
	Recordkeeping/Submission	3	0	3	As above, no change.
	Form Completion	1.4	0	1.4	
Note: Additional burden reduction of 15% applied to forms filed with TRI-ME software based on responses from software users.					

In developing the revised estimate of subsequent year burden hours for Form R calculations/report completion, EPA relied on data from 180 facilities on actual burden incurred due to TRI reporting. These data were available from the following sources:

- 1994 and 1995 Toxic Release Inventory: Data Quality Report
- 1996 Toxic Release Inventory: Data Quality Report
- 1999 Research Triangle Institute (RTI) Informal and Formal Surveys of TRI Burden

The specific interest expressed by OMB in the Terms of Clearance is the extent to which the available data, and by extension the revised burden hour estimates, account for all categories of burden, including time for data tracking and assembly; creation, operation and maintenance of data tracking systems; training; and compliance determinations. This interest can be addressed by examining the context of each data collection and questions that were asked.

Data Quality Reports

The Data Quality Reports for reporting years 1994-1996 were part of an EPA program of site surveys to assess the quality of TRI data and to identify areas where improved guidance would be useful for improving the accuracy of future reported data. Facilities were selected to obtain a random sample of facilities from key industries that permitted results to be scaled up to the entire industry group. The survey was conducted by the engineering staff of an EPA contractor. By design, the identities of specific facilities were never revealed to EPA. The EPA contractor conducted telephone interviews followed by site visits to review the methodology and data used by facilities to make the threshold calculations and release and transfer estimates (EPA 1998a, 1998b).

Most of each survey focused on how and where facilities obtained data on the use and waste management of TRI chemicals in their operations, and how they used these data to complete threshold determinations and release calculations. As a result, it is likely that the respondents were particularly aware of all the activities related to reporting that resulted in the expenditure of burden hours. Within the context of this reporting audit, the burden-specific question was framed broadly. Facilities were prompted to include time for familiarization with the regulation and reporting requirements, as well as activities to assemble data, make and review estimates, and document work. The burden-specific questions, which are reproduced in the following box, asked for the total time to comply with the TRI reporting requirements of EPCRA section 313.

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Data Quality Reports: Burden-specific questions

(RY94) What is your estimate of the time needed to fulfill the reporting requirements of Section 313 for 1994? Please include familiarization with the regulation and reporting instructions, completion and internal review of the reporting forms, and documentation of all information in your reports.

(RY95) What is your estimate of the time needed to fulfill the reporting requirements of Section 313 for 1995? Please include familiarization with the regulation and reporting instructions, completion and internal review of the reporting forms, and documentation of all information in your reports.

(RY96) What is your estimate of the time needed to fulfill the reporting requirements of Section 313 for 1996? Please include familiarization with the regulation and reporting instructions, completion and internal review of the reporting forms, and documentation of all information in your reports. (This is the total time for all Form Rs.)

RTI Surveys

The RTI surveys were small scoping activities with the primary intent of identifying factors influencing variability in burden hours at reporting facilities. Although there was a script of questions for interactions with the facilities, the conversations with facilities were fairly open-ended. Prior to asking for a burden hour estimate, the respondents were asked questions about the typical activities involved in complying with reporting requirements, how many and what type of staff were involved in reporting, what information sources were available, and which methods of estimation were used (RTI 1999a, 1999b).

Based on the results of the first (informal) survey, the burden-specific question for the second (formal) survey was modified slightly to elicit additional information on the specific activities comprising the burden hours. This included activities that contributed to the facilities' ability to complete the reporting form, but which were the result of other regulatory authorities or routine operating procedures. The questions, which are reproduced in the box below, asked for the average time to complete a single Form R (or the time to complete all the Form Rs at a facility):

RTI Surveys: Burden-specific questions

(Informal) How long does it take on average to fill one Form R? (If the time per form can not be estimated, then how long does it take to do all the forms?)

(Formal) On average, how long does it take to complete one Form R? (If the time per form can not be estimated, then how long does it take to fill all the forms)?

a) Please list the activities that you included in deriving this estimate?

b) What percentage of this estimate is related to other ongoing activities *(e.g., collecting data required for compliance with NPDES permits etc)?*

Additional Data and Analysis

During the public comment period for the last TRI ICR renewal, the American Petroleum Institute (API) submitted the results of a burden study covering TRI reporting year 2001 activities for 99 facilities in the petroleum refining and petroleum terminal and bulk station industries (API 2002). API subsequently provided EPA with the survey form and the data for individual facilities. The API survey questions addressed facility- and form-specific burden categories separately. The burden-specific questions from the API data collection are reproduced in the following box:

American Petroleum Institute Data Collection: Burden-specific questions

Number of hours spent on rule familiarization, including reviewing FR notices, instructions, EPA guidance, and so forth.

Number of hours spent making compliance determinations, including determining whether reporting thresholds are met.

Total number of hours spent per Form R (Include release calculations, completing form, mailing and recordkeeping, etc. Do not include rule familiarization and compliance determination.)

Although EPA reviewed the API data, these data were not used in the revised burden hour estimate for the March 2002 ICR renewal because of concerns about overweighting observations from the petroleum refining and petroleum terminal and bulk station industries. API's results are also confounded somewhat by the first year of reporting on lead and lead compounds at lower thresholds, with associated higher first-year reporting burdens. Nevertheless, the API results for total reporting burden were below or near the EPA revised

estimates when similar numbers of reports were assumed.

EPA subsequently conducted a statistical analysis using the API data, along with the original data from the Data Quality Reports and the RTI surveys (see Appendix A). The analysis used a prediction-based approach to estimate the burden associated with TRI reporting. First, linear regressions for each industry were estimated using the available data. Then, the parameter estimates were applied to the census data (*i.e.*, the data on forms per facility for each industry) to derive estimates of total reporting burden, the average time per Form R, the standard errors and confidence intervals. Overall, the average reporting burden per Form R was found to be 11.7 hours plus or minus 1.8 hours (Abt 2003). This is actually lower than the revised estimate used in the ICR renewal of 19.5 hours per Form R (composed of 14.5 for calculation/report completion and 5 hours for recordkeeping/submission) plus 4 hours per facility for compliance determination. It may be appropriate to think of the difference in estimates of total hours per form as potentially addressing various industry comments about additional time spent on training, guidance review, and other activities that are not individually estimated as part of EPA's revised burden hour estimate for subsequent year reporting.

Conclusion

Although EPA's revised estimate of 19.5 hours per Form R plus 4 hours per facility for compliance determination is more of an aggregated estimate than an estimate that is built-up from numerous discrete activities, there is little danger that the total reporting burden is underestimated. EPA's revised estimate is based on responses that reveal actual facility burden hours, and it is substantially higher than the average of these responses.

Furthermore, it should not be assumed that the only direction of possible bias in responses is downward because of incomplete specification of compliance activities. Based on previous experience interviewing facilities about compliance burden, facilities sometimes include burden that is incurred in complying with other regulations or in standard operating practices if data from those activities are ultimately used for TRI reporting. Although it is appropriate to attribute time spent arranging data and making estimates to complete Form R and A data elements to TRI compliance, it is not appropriate to attribute time spent complying with other regulations to TRI. Also, there is some possibility of strategic bias in industry responses to survey questions about the reporting burden of TRI reporting if the respondents believe that the responses may have some bearing on reporting requirements.

Although the burden-specific questions varied somewhat from data source to data source, facilities were encouraged in all cases to think comprehensively about the overall burden of TRI reporting. It seems reasonable to conclude that the available burden data are appropriate and adequate for the purpose of revising unit reporting burden estimates, especially in light of the validation provided by more recent burden data independently gathered by API. The sampled facilities reflect the experience of a broad range of industries reporting to TRI, and the data consistently show that existing estimates of reporting burden used by EPA are not an accurate representation of current reporting burden. The revised burden estimates in the latest

ICR renewal represent an improvement over the previous estimates from the 1980s, and their use would provide a more accurate representation of the burden of the TRI program on reporting facilities. The revised estimates would also provide a more accurate baseline for evaluation of potential investments in future TRI burden reduction initiatives.

REFERENCES

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APPENDIX A:

Memo on Estimation of TRI Reporting Burden

Abt Associates Inc.

MEMORANDUM

TO: Cody Rice, US EPA

FROM: Bill Rhodes, Susan Day

DATE: September 23, 2003

RE: Estimation of TRI Reporting Burden

The intent of this analysis is to estimate the average reporting burden associated with filing Form Rs and to provide a confidence interval for this burden. Two estimates are generated: average burden per facility and average burden per Form R.

The Data

Data reflecting the time spent filing Form Rs comes from three sources. They are included in Appendix A. Each source reports:

- The total time required to complete all forms filed by a facility. Time is either reported as a range with a lower and upper limit or as a point estimate.
- The Standard Industrial Classification (SIC) code. Two digit SIC codes were used in this analysis with the exception of SIC 5171.
- The number of Form Rs completed. This estimate was occasionally reported as a range with a lower and upper limit. When reported as a range, the range was converted to a point estimate equal to the midpoint of that range.

The first data set comes from the 1994, 1995, and 1996 Data Quality Reports. It was a random sample of facilities in key industries, defined as those that are large contributors to total releases (162 observations - one observation was excluded as an outlier). The second data set was the American Petroleum Institute (API) survey, which was limited to API members (99 observations in SIC codes 29 and 5171). The third data set was a small survey of facilities (18 observations - one observation was excluded because there was only one facility in SIC code 34) by RTI; these facilities were selected to explore the relationship between industry, number of reports and other factors potentially related to reporting burden. These three data sets, after exclusions, are collectively referred to as the *calibration data*. They are presented in Appendix

A.

The TRI data for RY2001 were also used in the analysis. These data represent a census of TRI facilities in RY2001. These data are referred to as the *prediction data*. The prediction data provided information on:

- SIC code
- Number of forms completed

The calibration data came from a period that predated the prediction data. It is assumed that the time spent per form has not changed materially between the time when the calibration data were collected and the time when the prediction data were collected. It is also assumed that the calibration data reflects subsequent year filings.

Estimation

Estimation uses a prediction-based approach described by Valliant, Dorfman and Royall (2000). The authors argue that, when a sampling procedure is biased, a prediction-based approach is required to overcome the bias. Moreover, even when a sampling procedure is unbiased, a prediction-based approach can provide estimates with lower mean-squared error than are
provided by traditional survey estimators. An overview of the prediction-based approach follows:

It is assumed that the relationship between burden and the number of Form Rs filed can be represented as a linear function:

$$B_{ij} = \beta_{0i} + \beta_{1i} F_{ij} + e_{ij} \qquad [1]$$

where:

B_{ij} The burden for the j^{th} facility in the i^{th} industry.
F_{ij} The number of Form Rs completed by the j^{th} facility in the i^{th} industry.

The β represents fixed parameters whose values may vary across the industries. The *e* are random errors terms. They are normally and independently distributed but groupwise heteroscedastic where the industry defines the group. In practice, model [1] is estimated by estimating separate regressions that are specific to each industry.

As noted earlier, the burden estimates were frequently reported as ranges, so model [1] could not be estimated directly. Instead, estimates were based on a likelihood function. When burden was reported as a range, the likelihood was written:

$$L_{ij} = \Phi(Z_{ij}^{H}) - \Phi(Z_{ij}^{L})$$

where:

$\Phi(...)$ is the standard normal central distribution function.

$$Z_{ij}^{H} = \frac{B_{ij}^{U} - \beta_{0i} - \beta_{1i} F_{ij}}{\sigma_i}$$

$$Z_{ij}^{L} = \frac{B_{ij}^{L} - \beta_{0i} - \beta_{1i} F_{ij}}{\sigma_i}$$

and

β_{ij}^{U} the upper limit reported by the j[th] respondent in the i[th] industry.

β_{ij}^{L} the lower limit reported by the j[th] respondent in the i[th] industry.

However, when the burden was reported as a point estimate, the likelihood was written as the density function:

$$L_{ij} = \frac{1}{\sqrt{2\pi\sigma_i^2}} e^{-\frac{1}{2}\left(\frac{B_{ij} - \beta_{0i} - \beta_{1i} F_{ij}}{\sigma_i^2}\right)^2}$$

Parameters were estimated using maximum likelihood. The estimated parameter covariance matrix is denoted V.

To derive the average reporting burden for an industry, the above regressions were estimated using the reporting burden data (calibration sample). The parameter estimates were then applied to predict the reporting burden for the census data (prediction data). Thus the average reporting burden for a member of industry i was estimated as:

$$\hat{B}_i = \frac{\sum_{j=1}^{J_i} \hat{\beta}_{0i} + \hat{\beta}_{1i} F_{ij}}{J_i} \qquad [2]$$

where J_i is the number of facilities that are in the prediction data for industry i. The sampling variance for the mean burden in industry i was estimated as:

$$\sigma^2_{B_i} = \gamma_i' X_i \hat{V}_i X_i' \gamma_i + \frac{\hat{\sigma}^2_i}{J_i} \qquad [3]$$

where:

X_i is a matrix with ones in the first column and $F_{ij}\,(j = 1 \ldots J_i)$ in the second column.

γ_i is a conformable column vector with every element equal to $1/J_i$.

For a derivation, see Valliant, Dorfman and Royall (2000), page 29.

Another way to express the estimation is:

$$\gamma' X_i = \begin{bmatrix} 1 & \overline{F}_i \end{bmatrix}$$

$$V = \begin{bmatrix} VAR(\beta_{0i}) & COV(\beta_{0i}, \beta_{1i}) \\ COV(\beta_{0i}, \beta_{1i}) & VAR(\beta_{i1}) \end{bmatrix}$$

so the first part of equation [3] can be rewritten as:

$$\gamma' X_i V X_i \gamma = VAR(\beta_{0i}) + VAR(\beta_{1i})\overline{F}_i^2 + 2COV(\beta_{01}, \beta_{1i})\overline{F}_i$$

Thus the first component of $\sigma^2_{B_i}$ depends on the precisions with which the β parameters can be estimated. Precision will increase with the size of the calibration sample. It is not affected by the size of the prediction sample.

Another way to consider the first component of $\sigma^2_{B_i}$ is that it is the sampling variance for the expected value of B_i conditional on $\overline{F}_i$. The actual mean will vary from this conditional mean because of the randomness in reporting burden from facility to facility given a constant F_{ij}. The difference will be smaller as the size of the census data gets larger – hence the second component of the variance term. Note that the size of this second term is not affected by the size of the calibration sample.

Results

Results from the regression analysis are summarized in appendix B table B-1. For each industry classification, the table reports regression parameter estimates and t-scores. The t-scores are the parameter estimates divided by the estimated standard errors.

Estimation of model [1] was attempted for ten SIC categories where data were available. In three cases, however, that was not possible. First, for SIC 5171, either a corporate parent or API apportioned total reporting burden across several facilities. As a result, most facilities in the data seemed to have the same reporting burden and the same number of Form Rs. There was so little variation in the number of Form Rs, in fact, that the regression indicated that $\hat{\beta}_{1i}$ was negative, an implausible result. Consequently, for SIC 5171, β_{0i} was forced to equal zero. Second, for SIC 29, the calibration sample did not represent the prediction sample. For reasons discussed subsequently, the regression provided more plausible predictions when the constant was constrained to zero. Finally, for SIC 35, there were only two observations. Estimates for the prediction sample were based on the mean for these two observations.

Residual plots confirmed that the regressions provided a reasonable specification of the relationship between reporting burden and Form Rs filed. Furthermore, with the exception of SIC 5171, the sample appeared to be *balanced*, so that model misspecification should have little effect on the resulting estimates. On this point, see Valliant, Dorfman and Royall (2000), page: 49-61.

Table 1 summarizes the data used in the model. The second and third columns present the sample sizes for both the calibration sample and the prediction census. The prediction census shows the number of facilities that filed at least one Form R. The last two columns show the average number of Form Rs in the calibration sample and the prediction census.

Table 1: Sample Size and Average Number of Form Rs

SIC Code	Sample Size		Average Form Rs	
	Calibration	Prediction	Calibration	Prediction
5171	75	499	7.6	7.0
28	52	3,330	6.2	5.1
33	29	1,946	3.2	3.6
29	26	511	26.0	8.1
30	24	1,828	3.3	2.2
25	23	326	2.5	2.0
37	20	1,325	3.7	3.4
36	14	1,193	2.9	2.6
26	12	525	6.3	6.2
35	2	1,086	1.5	2.5
Total	277	12,569	7.2	3.9

With one exception, the sample is balanced, meaning that the mean for the sample roughly equals the mean for the census. The exception is SIC 29, whose data came from the API Survey. (SIC 5171, which came from the same survey, did not suffer from the same problem.) In fact, while most of the observations from the calibration sample for SIC 29 came from facilities that filed a large number of Form Rs, most of the observations for the census came from facilities that filed fewer Form Rs.

Table 2 presents average reporting burden by SIC code. The *observed* average reporting burden by SIC code is shown in column two. This observed average was computed using the midpoint of the range when the reporting burden was reported as a range. Column three presents the *estimated* average reporting burden by SIC code. The standard error for that estimated average reporting burden is shown in column four. The weighted average reporting burden across all ten SIC codes is presented in the last row of the table. Weights are based on the number of facilities within each SIC classification.

Table 2: Average Reporting Burden by SIC Code

SIC	Calibration Sample	Prediction Census	
	Observed Average Time per Facility	Estimated Average Time per Facility	Standard Error
5171	48.5	43.40	2.30
28	69.4	58.53	13.12
33	35.0	37.36	5.17
29	598.9	200.00	27.10
30	29.2	25.57	3.70
25	21.7	18.63	1.86
37	61.1	57.30	14.80
36	32.4	25.82	4.82
26	43.0	41.71	4.88
35	33.0	33.00	2.12
Total		47.60	4.09

As shown in Table 2, on average, a facility spends nearly 48 hours filling out all of its Form Rs. An approximate 95 percent confidence interval, based on two standard deviations, is about 44 to 52 hours per facility. This estimate represents a weighted average where burden is weighted by the number of facilities within an SIC code. With the exception of SIC 29 and 5171, the average for the prediction sample is within two standard deviations of the average for the calibration sample. This makes sense because the samples are reasonably balanced.

For SIC 29, the average for the prediction sample is only about one-third the size of the average for the calibration sample. Furthermore, the predicted average for SIC 29 is much higher than the predicted average for all other industries. It is unclear whether this reflects reality or just

the uncertainty about estimating the average for SIC 29.

Note that the standard error for SIC 5171 is probably biased downward because of the way reporting burden estimates were collected. Specifically, total reporting burden at the corporate level was apportioned to facilities by the corporate parent or by API for several facilities. Thus, in the data set, many facilities have the same apparent reporting burden and the same apparent number of Form Rs. One implication is that while the predicted mean for industry 5171 appears to differ significantly from the calibration mean, this is probably because the sampling variance is underestimated.

Table 3 presents the estimated average reporting burden per Form R, computed by dividing the average reporting burden for the industry (from Table 2) by the average number of forms per SIC. The confidence interval shown is based on two standard deviations (approximately a 95 percent confidence interval). In the last row, the weighted average of the reporting burden across all SIC codes is presented. As before, the weights are based on the number of facilities within each SIC.

Table 3: Average Reporting Burden Per Form R

SIC	Prediction Census			
	Average Time per Form R	Standard Error	95 Percent Confidence Interval	
5171	6.24	0.33	5.58	6.90
28	11.43	2.56	6.31	16.55
33	10.24	1.42	7.40	13.07
29	24.62	3.34	17.95	31.30
30	11.72	1.70	8.32	15.12
25	9.11	0.91	7.29	10.93
37	16.74	4.32	8.10	25.38
36	10.02	1.87	6.28	13.76
26	6.77	0.79	5.19	8.35
35	13.40	0.86	11.68	15.12
Total	11.65	0.89	9.87	13.43

Overall, it appears that the average reporting burden is about 11.7 hours per Form R. If SIC 29 is excluded from these calculations, the overall average would fall to about 11.1 and the standard error would not change by much. Whatever the error when estimating the reporting burden for SIC 29, there is not much affect on the overall reporting burden per Form R.

Additional Comments

These estimates are limited to the 10 SIC codes for which there was data. To extend these estimates to other SIC codes would require an assumption that the ten industries observed in the calibration sample comprise a random sample of all industries that report to TRI. Were that the case, then random error models would be appropriate, and it would be possible to extend the estimates to industries not included in the sample. For an explanation, see McCulloch and Searle (2001). However, making such an assumption may not be appropriate given that selection of the above sample was purposeful. This extension was not pursued.

Note also that the covariance matrix from maximum likelihood estimation has an asymptotic justification. A sample of two (SIC = 35) probably does not comprise a sample of sufficient size that an asymptotic justification would apply. The same might be said of other samples. Thus, estimated variances should be treated as approximations. Nevertheless, as shown in Appendix B, an OLS model provides variance estimates that are close to those for the maximum likelihood estimates. This is encouraging because the OLS estimates are unbiased provided the error term is normal and identically distributed.

References

McCulloch, C. and Searle, S. Generalized, Linear, and Mixed Models. John Wiley & Sons, 2001.

Valliant, R., Dorfman, A. and Royall, R. Finite Population Sampling and Inference. John Wiley & Sons, 2000.

Appendix A
Calibration Data Set

SIC	FORM_MIN	FORM_MAX	HOUR_MIN	HOUR_MAX	SOURCE
25	5	5	21	50	DQ94
25	2	2	0	20	DQ94
25	3	3	21	50	DQ94
25	4	4	21	50	DQ94
25	5	5	21	50	DQ94
25	2	2	0	20	DQ94
25	1	1	0	20	DQ94
25	1	1	50	100	DQ94
25	9	9	50	100	DQ94
25	3	3	21	50	DQ94
25	2	2	0	20	DQ94
25	1	1	21	50	DQ94
25	7	7	0	20	DQ94
25	1	1	21	50	DQ94
25	1	1	21	50	DQ94
25	3	3	0	20	DQ94
25	1	1	21	50	DQ94
25	5	5	21	50	DQ94
25	6	6	0	20	DQ94
25	2	2	21	50	DQ94
25	1	1	0	20	DQ94
25	8	8	21	50	DQ94
25	5	5	21	50	DQ94
25	1	1	0	20	DQ94
26	1	1	0	8	DQ95
26	8	8	21	40	DQ95
26	3	3	41	100	DQ95
26	3	3	21	40	DQ95
26	4	4	21	40	DQ95
26	2	2	0	8	DQ95
26	5	5	9	20	DQ95
26	7	7	21	40	DQ95
26	6	6	41	100	DQ95
26	14	14	0	100	DQ95
26	9	11	72	88	RTI-1
26	13	13	100	100	RTI-2
28	1	1	21	50	DQ94
28	3	3	0	20	DQ94
28	7	7	0	20	DQ94
28	5	5	21	50	DQ94
28	1	1	0	20	DQ94
28	3	3	0	20	DQ94

SIC	FORM_MIN	FORM_MAX	HOUR_MIN	HOUR_MAX	SOURCE
28	9	9	50	100	DQ94
28	4	4	0	20	DQ94
28	4	4	21	50	DQ94
28	9	9	50	100	DQ94
28	5	5	0	20	DQ94
28	7	7	100	200	DQ94
28	14	14	50	100	DQ94
28	2	2	21	50	DQ94
28	4	4	0	20	DQ94
28	5	5	0	20	DQ94
28	3	3	0	20	DQ94
28	8	8	21	50	DQ94
28	2	2	0	20	DQ94
28	2	2	21	50	DQ94
28	5	5	21	50	DQ94
28	4	4	21	50	DQ94
28	8	8	100	200	DQ94
28	1	1	0	20	DQ94
28	9	9	0	20	DQ94
28	1	1	0	20	DQ94
28	6	6	21	50	DQ94
28	2	2	0	20	DQ94
28	6	6	0	20	DQ94
28	1	1	21	50	DQ94
28	4	4	21	50	DQ94
28	2	2	0	20	DQ94
28	4	4	0	20	DQ94
28	1	1	0	20	DQ94
28	3	3	0	20	DQ94
28	2	2	0	20	DQ94
28	5	5	41	100	DQ95
28	11	11	41	100	DQ95
28	19	19	0	100	DQ95
28	5	5	41	100	DQ95
28	15	15	41	100	DQ95
28	1	1	0	8	DQ95
28	2	2	21	40	DQ95
28	2	2	0	8	DQ95
28	13	13	41	100	DQ95
28	13	13	41	100	DQ95
28	29	29	400	400	RTI-1
28	9	11	160	160	RTI-1
28	4	5	320	480	RTI-1
28	5	5	380	380	RTI-2
28	10	10	480	480	RTI-2
28	20	20	160	160	RTI-2
29	26	26	248	424	RTI-1
29	23	23	640	640	RTI-2

SIC	FORM_MIN	FORM_MAX	HOUR_MIN	HOUR_MAX	SOURCE
29	36	36	1143	1143	API
29	25	25	304	304	API
29	21	21	580	580	API
29	39	39	1152	1152	API
29	18	18	188	188	API
29	18	18	654	654	API
29	26	26	488	488	API
29	12	12	173	173	API
29	43	43	1057	1057	API
29	30	30	588	588	API
29	24	24	948	948	API
29	18	18	188	188	API
29	18	18	188	188	API
29	12	12	173	173	API
29	31	31	143	143	API
29	35	35	1695	1695	API
29	37	37	319	319	API
29	12	12	173	173	API
29	45	45	1333	1333	API
29	25	25	174	174	API
29	25	25	620	620	API
29	36	36	1884	1884	API
29	24	24	242	242	API
29	18	18	188	188	API
30	1	1	0	20	DQ94
30	1	1	0	20	DQ94
30	2	2	0	20	DQ94
30	3	3	21	50	DQ94
30	6	6	21	50	DQ94
30	3	3	0	20	DQ94
30	1	1	0	20	DQ94
30	1	1	0	20	DQ94
30	15	15	50	100	DQ94
30	1	1	0	20	DQ94
30	2	2	0	20	DQ94
30	2	2	21	50	DQ94
30	1	1	0	20	DQ94
30	3	3	0	20	DQ94
30	3	3	21	50	DQ94
30	2	2	0	20	DQ94
30	1	1	21	50	DQ94
30	2	2	21	50	DQ94
30	1	1	0	20	DQ94
30	2	2	0	20	DQ94
30	1	1	21	50	DQ94
30	3	3	21	50	DQ94
30	1	1	0	20	DQ94

SIC	FORM_MIN	FORM_MAX	HOUR_MIN	HOUR_MAX	SOURCE
33	1	1	41	100	DQ96
33	4	4	21	40	DQ96
33	5	5	9	20	DQ96
33	1	1	0	8	DQ96
33	9	9	21	40	DQ96
33	4	4	41	100	DQ96
33	2	2	9	20	DQ96
33	5	5	120	120	DQ96
33	2	2	21	40	DQ96
33	1	1	0	8	DQ96
33	4	4	21	40	DQ96
33	1	1	41	100	DQ96
33	1	1	9	20	DQ96
33	3	3	21	40	DQ96
33	10	10	41	100	DQ96
33	4	4	9	20	DQ96
33	1	1	21	40	DQ96
33	1	1	0	8	DQ96
33	1	1	0	8	DQ96
33	1	1	0	8	DQ96
33	3	3	0	8	DQ96
33	1	1	0	8	DQ96
33	2	2	9	20	DQ96
33	2	2	21	40	DQ96
33	1	1	41	100	DQ96
33	3	3	21	40	DQ96
33	2	2	6	6	RTI-1
33	4	4	32	32	RTI-1
33	13	13	160	160	RTI-2
34	1	1	8	8	RTI-2
35	2	2	30	30	RTI-1
35	1	1	36	36	RTI-2
36	1	1	0	8	DQ96
36	7	7	21	40	DQ96
36	1	1	9	20	DQ96
36	6	6	41	100	DQ96
36	2	2	9	20	DQ96
36	4	4	9	20	DQ96
36	1	1	0	8	DQ96
36	1	1	21	40	DQ96
36	4	4	41	100	DQ96
36	5	5	9	20	DQ96
36	4	4	21	40	DQ96
36	1	1	9	20	DQ96
36	3	3	41	100	DQ96
36	1	1	41	100	DQ96
37	2	2	0	8	DQ96

SIC	FORM_MIN	FORM_MAX	HOUR_MIN	HOUR_MAX	SOURCE
37	2	2	0	8	DQ96
37	2	2	0	8	DQ96
37	4	4	21	40	DQ96
37	4	4	9	20	DQ96
37	3	3	41	100	DQ96
37	2	2	41	100	DQ96
37	1	1	0	8	DQ96
37	3	3	41	100	DQ96
37	3	3	160	160	DQ96
37	1	1	0	8	DQ96
37	11	11	41	100	DQ96
37	14	14	200	200	DQ96
37	1	1	9	20	DQ96
37	4	4	41	100	DQ96
37	2	2	21	40	DQ96
37	3	3	9	20	DQ96
37	1	1	9	20	DQ96
37	6	6	320	320	RTI-1
37	4	6	40	60	RTI-2
5171	8	8	40	40	API
5171	7	7	66	66	API
5171	8	8	40	40	API
5171	8	8	40	40	API
5171	8	8	40	40	API
5171	7	7	66	66	API
5171	8	8	40	40	API
5171	8	8	40	40	API
5171	7	7	66	66	API
5171	7	7	66	66	API
5171	7	7	66	66	API
5171	8	8	25	25	API
5171	8	8	25	25	API
5171	7	7	66	66	API
5171	8	8	25	25	API
5171	8	8	25	25	API
5171	7	7	66	66	API
5171	8	8	25	25	API
5171	7	7	66	66	API
5171	7	7	66	66	API
5171	7	7	66	66	API
5171	8	8	60	60	API
5171	7	7	66	66	API
5171	7	7	66	66	API
5171	8	8	40	40	API
5171	8	8	60	60	API
5171	7	7	66	66	API
5171	8	8	60	60	API

SIC	FORM_MIN	FORM_MAX	HOUR_MIN	HOUR_MAX	SOURCE
5171	7	7	66	66	API
5171	8	8	40	40	API
5171	8	8	40	40	API
5171	7	7	66	66	API
5171	8	8	40	40	API
5171	7	7	17	17	API
5171	7	7	66	66	API
5171	7	7	17	17	API
5171	9	9	22	22	API
5171	9	9	22	22	API
5171	7	7	66	66	API
5171	9	9	22	22	API
5171	8	8	59	59	API
5171	7	7	66	66	API
5171	8	8	59	59	API
5171	8	8	59	59	API
5171	7	7	66	66	API
5171	8	8	59	59	API
5171	8	8	59	59	API
5171	7	7	66	66	API
5171	9	9	22	22	API
5171	8	8	46	46	API
5171	7	7	66	66	API
5171	8	8	46	46	API
5171	7	7	66	66	API
5171	7	7	17	17	API
5171	7	7	17	17	API
5171	7	7	66	66	API
5171	7	7	17	17	API
5171	8	8	46	46	API
5171	7	7	66	66	API
5171	8	8	60	60	API
5171	7	7	66	66	API
5171	8	8	40	40	API
5171	8	8	25	25	API
5171	7	7	66	66	API
5171	8	8	25	25	API
5171	8	8	40	40	API
5171	7	7	66	66	API
5171	8	8	40	40	API
5171	8	8	25	25	API
5171	8	8	40	40	API
5171	7	7	66	66	API
5171	8	8	40	40	API
5171	8	8	40	40	API
5171	7	7	66	66	API
5171	8	8	40	40	API

Appendix B
Regression Results

Table B-1 presents the regression results based on the calibration data.

CONST	denotes that a constant entered the regression.
FORMS	denotes that the number of forms that entered the regression.
R-SQUARE	R^2 corrected for degrees of freedom. NA indicates that no R^2 was reported when the model lacked a constant.
STANDARD ERROR	estimated standard error for the regression residuals.

Results are first reported for the OLS estimates, for which measured burden was set equal to the midpoint of the reported range. The T-score is the parameter estimate divided by its standard error. The parameter estimate and T-score have similar interpretations for the maximum likelihood estimation, for which the T-score has an asymptotic justification.

Table B-1: Regression Results

	OLS Estimation		Maximum Likelihood Estimation	
Industry	Parameter	T-score	Parameter	T-Score
5171				
FORMS	6.24	20.41	6.24	20.55
STANDARD ERROR	20.20		20.06	6.12
R-SQUARE	NA			
28				
CONST	12.18	0.61	10.20	0.53
FORMS	9.25	3.82	9.45	4.09
STANDARD ERROR	95.93		91.49	4.98
R-SQUARE	0.21			
33				
CONST	10.62	1.29	7.03	0.94
FORMS	7.68	4.01	8.31	4.72
STANDARD ERROR	30.10		26.43	3.47
R-SQUARE	0.35			
29				
FORMS	24.61	9.12	24.62	9.30
STANDARD ERROR	380.37		372.90	3.60
R-SQUARE	NA			
30				
CONST	23.15	3.59	22.08	3.97
FORMS	1.85	1.17	1.60	1.16

	OLS Estimation		Maximum Likelihood Estimation	
Industry	Parameter	T-score	Parameter	T-Score
STANDARD ERROR	18.54		14.25	2.87
R-SQUARE	0.02			
25				
CONST	10.86	3.46	10.00	2.85
FORMS	4.30	5.27	3.73	2.18
STANDARD ERROR	11.35		6.46	1.47
R-SQUARE	0.55			
37				
CONST	10.55	0.46	9.79	0.44
FORMS	13.65	2.91	13.89	3.09
STANDARD ERROR	68.30		64.87	3.14
R-SQUARE	0.28			
36				
CONST	21.11	1.72	17.16	2.11
FORMS	3.86	1.12	3.36	1.43
STANDARD ERROR	26.11		16.55	2.03
R-SQUARE	0.02			
26				
CONST	13.16	0.98	1.85	0.21
FORMS	4.70	2.63	6.47	5.19
STANDARD ERROR	25.11		15.53	1.94
R-SQUARE	0.35			

The maximum likelihood parameter estimates correspond to the β parameters from equation [1] in the main text. For reasons explained in the main text, the regression specification excluded a constant (CONST) for SIC codes 5171 and 29. The t-score is the ratio of the parameter estimate and its estimated standard error. The table also reports the estimated residual standard error for the regression.

For example, for SIC code 28, the constant was 10.20 with a t-score of 0.53. The incremental burden per form was 9.45 with a t-score of 4.09. Depending on the criterion used, a t-score in excess of 1.96 might be judged as being statistically significant. The parameter associated with the FORMS variable is not significant for SIC codes 30 and 36 according to this criterion. Nevertheless, a variable does not have to have a significant parameter to be a useful predictor, so the FORMS variable is always used when making predictions.

An ordinary least squares regression was estimated as a check. Parameter estimates are similar between the two models. The OLS model provides a straightforward estimate of explained

variance (R^2). Explained variance is very low in two regressions; software does not compute an R^2 when the model specification lacks a constant.